# Tech Saksham

Capstone Project Report

**ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTALS**

# EMAIL SPAM DETECTION

**KINGSTON ENGINEERING COLLEGE**

| NM ID | NAME |
|---|---|
| autle-05eee | CHARAN T |

Trainer Name

Master Trainer

**RAMAR BOSE**

# ABSTRACT

Nowadays, a big part of people rely on available email or messages sent by the stranger. The possibility that anybody can leave an email or a message provides a golden opportunity for spammers to write spam message about our different interests .Spam fills inbox with number of ridiculous emails . Degrades our internet speed to a great extent .Steals useful information like our details on our contact list. Identifying these spammers and also the spam content can be a hot topic of research and laborious tasks. Email spam is an operation to send messages in bulk by mail .Since the expense of the spam is borne mostly by the recipient ,it is effectively postage due advertising. Spam email is a kind of commercial advertising which is economically viable because email could be a very cost effective medium for sender .With this proposed model the specified message can be stated as spam or not using Bayes' theorem and Naive Bayes' Classifier and Also IP addresses of the sender are often detected .

# INDEX

# CHAPTER 1

# INTRODUCTION

Today, Spam has become a major problem in communication over internet. It has been accounted that around 55% of all emails are reported as spam and the number has been growing steadily. Spam which is also known as unsolicited bulk email has led to the increasing use of email as email provides the perfect ways to send the unwanted advertisement or junk newsgroup posting at no cost for the sender. This chances has been extensively exploited by irresponsible organizations and resulting to clutter the mail boxes of millions of people all around the world. Spam has been a major concern given the offensive content of messages, spam is a waste of time. End user is at risk of deleting legitimate mail by mistake. Moreover, spam also impacted the economical which led some countries to adopt legislation. Text classification is used to determine the path of incoming mail/message either into inbox or straight to spam folder. It is the process of assigning categories to text according to its content. It is used to organized, structures and categorize text. It can be done either manually or automatically. Machine learning automatically classifies the text in a much faster way than manual technique. Machine learning uses pre-labelled text to learn the different associations between pieces of text and it output. It used feature extraction to transform each text to numerical representation in form of vector which represents the frequency of word in predefined dictionary. Text classification is important to structure the unstructured and messy nature of text such as documents and spam messages in a cost-effective way. Machine learning can make more accurate precisions in real-time and help to improve the manual slow process to much better and faster analysing big data. It is important especially to a company to analyse text data, help inform business decisions and even automate business processes. In this project, machine learning techniques are used to detect the spam message of a mail. Machine learning is where computers can learn to do something 10 without the need to explicitly program them for the task. It uses data and produce a program to perform a task such as classification. Compared to knowledge engineering, machine learning techniques require messages that have been successfully pre-classified. The pre-classified messages make the training dataset which will be used to fit the learning algorithm to the model in machine learning studio. A combination of algorithms are used to learn the classification rules from messages. These algorithms are used for classification of objects of different classes. These algorithms are provided with pre labelled data and an unknown text. After learning from the prelabelled data each of these algorithms predict which class the unknown text may belong to and the category predicted by majority is considered as final.

## 1.1 Problem Statement

Unwanted e-mails irritating internet connection

Critical e-mail message are missed and delayed

Millions of compromised computers

It  occupies more space in the cloud

Identity theft

Spam can crash mail servers and fil up hard drives

## 1.2 Proposed Solution

In this system, to solve the problem of spam, the spam classification system is created to identify spam and nonspam. Since spammers may send spam messages many times, it is difficult to identify it every time manually .So we will be using some of the strategies in our proposed system to detect the spam. The proposed solution not only identifies the spam word but also identifies the IP address of the system through which the spam message is sent so that next time when the spam message is sent from the same system our proposed system directly identifies it as blacklisted based on the IP address. In the proposed model ,the web application is done using dot net and spam detection is done using machine learning .The web application consists of following modules:

## 1.3Feature

Email spam detection relies on a variety of features extracted from email data to distinguish between spam and legitimate messages. These features serve as input variables for machine learning algorithms and statistical models used in spam detection systems. Here are some common features used in email spam detection:

1. **Sender Information**: Characteristics of the email sender, including the sender's email address, domain reputation, sender's IP address, and authentication status (e.g., SPF, DKIM, DMARC). Anomalies or inconsistencies in sender information can indicate potential spam.
2. **Content Analysis**: Analysis of the textual content of the email, including subject line, body text, and embedded links. Features extracted from content analysis may include:
    - Presence of spam-related keywords or phrases (e.g., "free," "discount," "limited time offer").
    - Frequency of certain words or phrases.
    - Use of HTML or rich text formatting.
    - Presence of misspellings, unusual characters, or obfuscation techniques.

3. **Metadata Analysis**: Examination of metadata associated with the email, such as timestamp, message ID, and header information. Metadata features may include:
    - Time of day the email was sent.
    - Geolocation of the sender's IP address.
    - Number of recipients.
    - Email client or software used to send the email.
4. **Structural Analysis**: Analysis of the structural characteristics of the email, including:
    - Number of recipients (to, cc, bcc).
    - Presence of attachments or embedded media files.
    - MIME type of attachments.
    - HTML code analysis for suspicious elements (e.g., hidden text, invisible links).
5. **URL Analysis**: Examination of URLs contained within the email, including:
    - URL length and format.
    - Domain reputation of linked websites.
    - Presence of URL redirects or URL shortening services.
    - Blacklisted or suspicious domains.
6. **Header Analysis**: Inspection of email headers for anomalies or signs of spoofing, including:
    - Consistency between the "From" header and the sender's domain.
    - Presence of additional headers indicating email routing or forwarding.
    - Use of email authentication mechanisms (e.g., SPF, DKIM, DMARC).
7. **Behavioral Analysis**: Analysis of user behavior and interaction patterns with emails, such as:
    - User engagement metrics (e.g., open rate, click-through rate).
    - Frequency of marking emails as spam or moving them to spam folders.
    - Analysis of historical email interactions and user preferences.
8. **Machine Learning-Based Features**: Derived features generated through machine learning algorithms, such as:
    - Predicted probability scores from spam detection models.
    - Feature importance scores indicating the contribution of each feature to the classification decision.
    - Clustering or grouping of emails based on similarity in feature space.

## 1.4Advantage

- Protection Against Malicious Activities:
- Enhanced Productivity:
- Improved User Experience
- Protection Against Offensive Content
- Reduced Risk of Security Breaches
- Preservation of Network Bandwidth
- Compliance with Regulations:
- Cost Savings

## 1.5Scope

- **It provides sensitivity to the client and adapts well to the**
- **Future spam techniques**
- **It considers a complete message instead of single words with**
- **Respect to its organization**
- **It increases security and control**
- **It reduces IT administration costs**
- **It also reduce Network Resource costs**

## 1.3 Future work

The future work of email spam detection will likely focus on addressing emerging challenges and leveraging advanced technologies to improve detection accuracy, efficiency, and user experience. Here are some potential areas of future research and development

- **Deep Learning Techniques**:
- **Unsupervised Learning Approaches**
- **Multi-Modal Analysis**
- **Contextual Analysis**
- **Adversarial Defense Mechanisms**:
- **Privacy-Preserving Techniques**
- **Real-Time Feedback Loops**:
- **Cross-Platform Integration**
- **Explainable AI (XAI)**:

# CHAPTER 2

# SERVICES AND TOOLS REQUIRED

## 2.1 Services Used

Email spam detection typically involves the utilization of various services, both standalone and integrated within larger email security solutions. Here are some key services commonly used for email spam detection

**Email Authentication Service**

**URL and Domain Reputation Services**

**Threat Intelligence Feeds**

**Machine Learning and AI Services**

**Anomaly Detection Services**

**Reporting and Feedback Mechanisms**

**Cloud-Based Spam Filtering Services**

**Managed Security Services**

**Anti-Spam Filtering Services**

## 2.2 Tools and Software used

## Tools and software  used of email spam detection

**Cisco Email Security**

**Microsoft Exchange Online Protection (EOP)**

**SpamTitan**

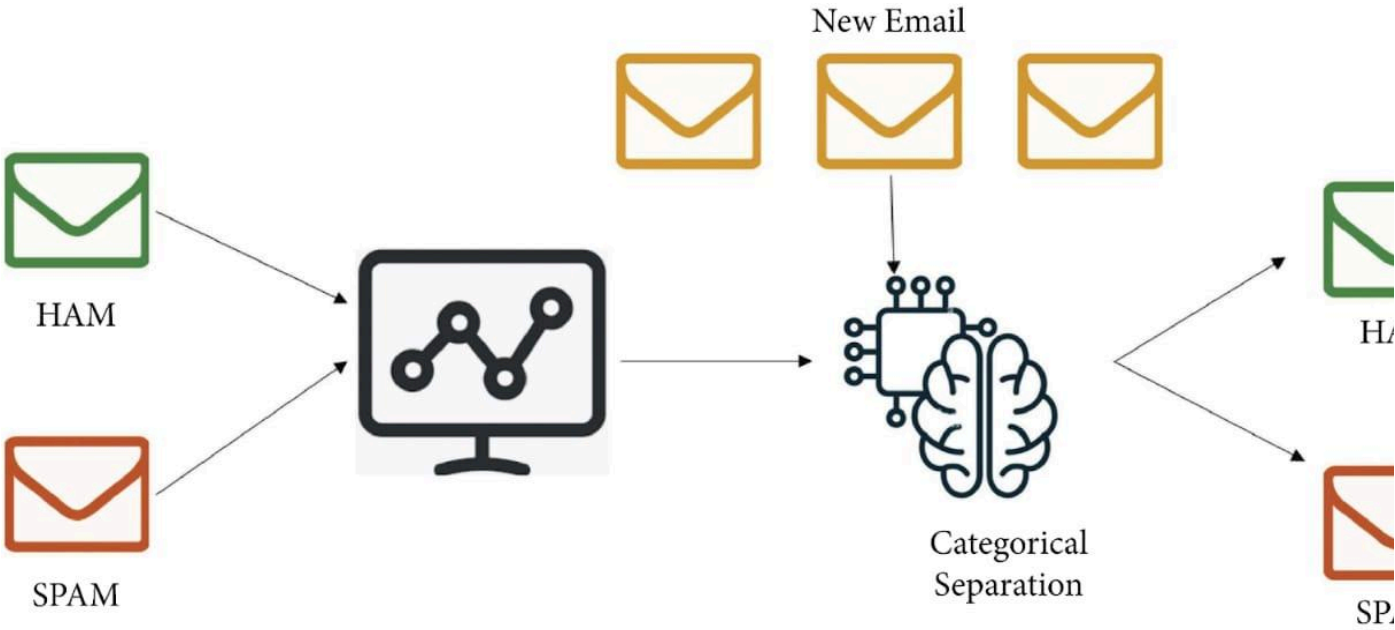
**SpamAssassin**

**MailScanner**

# CHAPTER 3

# PROJECT ARCHITECTURE

## 3.1 Architecture



# CHAPTER 4

# PROJECT OUTCOME

The project outcome of an email spam detection endeavor can vary depending on the specific goals, scope, and requirements of the project. However, here are some potential project outcomes that can be achieved:

1. **Development of a Functional Spam Detection System**: The primary outcome of the project may be the successful development and implementation of a functional email spam detection system. This system would be capable of automatically classifying incoming emails as either spam or legitimate based on various features and criteria.
2. **High Accuracy in Spam Detection**: The project outcome may include achieving high levels of accuracy in spam detection, as measured by metrics such as precision, recall, F1-score, and accuracy. A well-performing spam detection system should minimize false positives (legitimate emails classified as spam) and false negatives (spam emails classified as legitimate).
3. **Integration with Email Platforms**: The spam detection system may be integrated into email servers, clients, or filtering gateways to provide real-time protection against spam. Integration with existing email platforms ensures seamless operation and user accessibility.
4. **User-Friendly Interface**: The project may result in the development of a user-friendly interface that allows users to manage spam filtering preferences, view spam detection results, and provide feedback on detected emails. A intuitive interface enhances user experience and engagement with the spam detection system.
5. **Scalability and Efficiency**: The spam detection system should be scalable and efficient, capable of handling large volumes of incoming emails without significant performance degradation. Optimized algorithms and data processing techniques contribute to scalability and efficiency.
6. **Adaptability to New Threats**: The outcome may include mechanisms for continuous monitoring and adaptation to new spamming techniques and emerging threats. The spam detection system should be able to dynamically adjust its algorithms and criteria to effectively detect and mitigate evolving spam campaigns.
7. **Compliance with Regulations**: If applicable, the project outcome may involve ensuring compliance with relevant regulations and standards governing email communications and data privacy. This may include adherence to regulations such as the CAN-SPAM Act or GDPR.
8. **Documentation and Reporting**: Comprehensive documentation and reporting on the project outcomes, including details of the spam detection system architecture, algorithms used, performance metrics achieved, and user feedback. Clear documentation facilitates knowledge transfer and future maintenance of the system.

9. **Training and Support Materials**: Creation of training materials and user guides to assist users in understanding and effectively utilizing the spam detection system. Providing ongoing support and training ensures optimal use and adoption of the system.
10. **Evaluation and Validation**: The project outcome may include thorough evaluation and validation of the spam detection system's performance through testing, validation, and benchmarking against benchmark datasets or real-world email traffic. Validation ensures that the system meets the desired objectives and performance criteria.

```
import pandas as pd


Code cell <4Y2WaOc0EDuq>

# %% [code]

df = pd.read_csv('/content/archive.zip')

df

Execution output from Apr 20, 2024 12:59 PM

26KB

    text/plain

        Address    Lot AM or PM  \

        0     16629 Pace Camp Apt. 448\nAlexisborough, NE 77...  46 in
PM

        1     9374 Jasmine Spurs Suite 508\nSouth John, TN 8...  28 rn
PM

        2                      Unit 0065 Box 5052\nDPO AP 27450  94 vE
PM

        3                 7780 Julia Fords\nNew Stacy, WA 45798  36 vm
PM

        4     23012 Munoz Drive Suite 337\nNew Cynthia, TX 5...  20 IE
AM

        ...                                                 ...    ...
...

        9995      966 Castaneda Locks\nWest Juliafurt, CO 96415  92 XI
PM
```

```
        9996  832 Curtis Dam Suite 785\nNorth Edwardburgh, T...  41 JY
AM
        9997              Unit 4434 Box 6343\nDPO AE 28026-0283  74 Zh
AM
        9998               0096 English Rest\nRoystad, IA 12457  74 cL
PM
        9999     40674 Barrett Stravenue\nGrimesville, WI 79682  64 Hr
AM


                                                  Browser Info  \
        0     Opera/9.56.(X11; Linux x86_64; sl-SI) Presto/2...
        1     Opera/8.93.(Windows 98; Win 9x 4.90; en-US) Pr...
        2     Mozilla/5.0 (compatible; MSIE 9.0; Windows NT ...
        3     Mozilla/5.0 (Macintosh; Intel Mac OS X 10_8_0 ...
        4     Opera/9.58.(X11; Linux x86_64; it-IT) Presto/2...
        ...                                                 ...
        9995  Mozilla/5.0 (Windows NT 5.1) AppleWebKit/5352 ...
        9996  Mozilla/5.0 (compatible; MSIE 9.0; Windows NT ...
        9997  Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_7...
        9998  Mozilla/5.0 (Macintosh; Intel Mac OS X 10_8_8;...
        9999  Mozilla/5.0 (X11; Linux i686; rv:1.9.5.20) Gec...


                                    Company       Credit Card CC Exp
Date  \
        0                     Martinez-Herman  6011929061123406
02/20
        1     Fletcher, Richards and Whitaker  3337758169645356
11/18
        2          Simpson, Williams and Pham      675957666125
08/19
        3     Williams, Marshall and Buchanan  6011578504430710
02/24
```

```
        4            Brown, Watson and Andrews  6011456623207998
10/25

        ...                               ...               ...
...

        9995                    Randall-Sloan   342945015358701
03/22

        9996         Hale, Collins and Wilson   210033169205009
07/25

        9997                     Anderson Ltd  6011539787356311
05/21

        9998                         Cook Inc   180003348082930
11/17

        9999                      Greene Inc  4139972901927273
02/19


              CC Security Code                  CC Provider  \
        0                  900                JCB 16 digit
        1                  561                  Mastercard
        2                  699                JCB 16 digit
        3                  384                    Discover
        4                  678  Diners Club / Carte Blanche
        ...                ...                         ...
        9995               838                JCB 15 digit
        9996               207                JCB 16 digit
        9997                 1               VISA 16 digit
        9998               987             American Express
        9999               302                JCB 15 digit


                                      Email
Job  \
        0                 pdunlap@yahoo.com  Scientist, product/process
development
```

```
        1                anthony41@reed.com                          
Drilling engineer
        2     amymiller@morales-harrison.com                Customer
service manager
        3        brent16@olson-robinson.info                         
Drilling engineer
        4        christopherwright@gmail.com                         
Fine artist
        ...                              ...                         
...
        9995          iscott@wade-garner.com                         
Printmaker
        9996             mary85@hotmail.com                          
Energy engineer
        9997              tyler16@gmail.com                          
Veterinary surgeon
        9998         elizabethmoore@reid.net                Local
government officer
        9999           rachelford@vaughn.com                         
Embryologist, clinical


               IP Address Language  Purchase Price
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        1        15.160.41.51       fr           70.73
        2      132.207.160.22       de            0.95
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        4        24.140.33.94       es           77.82
        ...               ...      ...             ...
        9995    29.73.197.114       it           82.21
        9996   121.133.168.51       pt           25.63
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        [10000 rows x 14 columns]


Code cell <87OKK39ME87S>
# %% [code]
df.head(10)
Execution output from Apr 20, 2024 12:59 PM
23KB
    text/plain
        Address    Lot AM or PM  \
        0  16629 Pace Camp Apt. 448\nAlexisborough, NE 77...  46 in
PM
        1  9374 Jasmine Spurs Suite 508\nSouth John, TN 8...  28 rn
PM
        2                   Unit 0065 Box 5052\nDPO AP 27450  94 vE
PM
        3              7780 Julia Fords\nNew Stacy, WA 45798  36 vm
PM
        4  23012 Munoz Drive Suite 337\nNew Cynthia, TX 5...  20 IE
AM
        5  7502 Powell Mission Apt. 768\nTravisland, VA 3...  21 XT
PM
        6     93971 Conway Causeway\nAndersonburgh, AZ 75107  96 Xt
AM
        7  260 Rachel Plains Suite 366\nCastroberg, WV 24...  96 pG
PM
        8            2129 Dylan Burg\nNew Michelle, ME 28650  45 JN
PM
        9    3795 Dawson Extensions\nLake Tinafort, ID 88739  15 Ug
AM
```

```
                                          Browser Info  \
0  Opera/9.56.(X11; Linux x86_64; sl-SI) Presto/2...
1  Opera/8.93.(Windows 98; Win 9x 4.90; en-US) Pr...
2  Mozilla/5.0 (compatible; MSIE 9.0; Windows NT ...
3  Mozilla/5.0 (Macintosh; Intel Mac OS X 10_8_0 ...
4  Opera/9.58.(X11; Linux x86_64; it-IT) Presto/2...
5  Mozilla/5.0 (Macintosh; U; PPC Mac OS X 10_8_5...
6  Mozilla/5.0 (compatible; MSIE 7.0; Windows NT ...
7  Mozilla/5.0 (X11; Linux i686) AppleWebKit/5350...
8  Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_7...
9  Mozilla/5.0 (X11; Linux i686; rv:1.9.7.20) Gec...

                          Company       Credit Card CC Exp Date
\
0                 Martinez-Herman  6011929061123406       02/20
1  Fletcher, Richards and Whitaker  3337758169645356       11/18
2       Simpson, Williams and Pham      675957666125       08/19
3  Williams, Marshall and Buchanan  6011578504430710       02/24
4        Brown, Watson and Andrews  6011456623207998       10/25
5                  Silva-Anderson    30246185196287       07/25
6                 Gibson and Sons  6011398782655569       07/24
7                Marshall-Collins      561252141909       06/25
8               Galloway and Sons    180041795790001       04/24
9    Rivera, Buchanan and Ramirez     4396283918371       01/17

   CC Security Code                 CC Provider  \
0               900                JCB 16 digit
1               561                  Mastercard
2               699                JCB 16 digit
```

```
        3               384                     Discover
        4               678  Diners Club / Carte Blanche
        5              7169                     Discover
        6               714                VISA 16 digit
        7               256                VISA 13 digit
        8               899                 JCB 16 digit
        9               931             American Express


                                  Email
Job  \
        0               pdunlap@yahoo.com  Scientist, product/process
development
        1              anthony41@reed.com                       Drilling
engineer
        2  amymiller@morales-harrison.com               Customer
service manager
        3     brent16@olson-robinson.info                       Drilling
engineer
        4     christopherwright@gmail.com
Fine artist
        5               ynguyen@gmail.com                       Fish
farm manager
        6              olivia04@yahoo.com
Dancer
        7            phillip48@parks.info                         Event
organiser
        8            kdavis@rasmussen.com
Financial manager
        9        qcoleman@hunt-huerta.com                     Forensic
scientist


               IP Address Language  Purchase Price
        0  149.146.147.205       el           98.14
```

```
        1     15.160.41.51       fr           70.73
        2   132.207.160.22       de            0.95
        3     30.250.74.19       es           78.04
        4     24.140.33.94       es           77.82
        5    55.96.152.147       ru           25.15
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        9    236.198.199.8       zh           95.63


Code cell <S1j1ztauFWMR>
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Execution output from Apr 20, 2024 12:59 PM
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        9990  75731 Molly Springs\nWest Danielle, VT 96934-5102  93 ty
PM
        9991              PSC 8165, Box 8498\nAPO AP 60327-0346  50 dA
AM
        9992  885 Allen Mountains Apt. 230\nWallhaven, LA 16995  40 vH
PM
        9993  7555 Larson Locks Suite 229\nEllisburgh, MA 34...  72 jg
PM
        9994       6276 Rojas Hollow\nLake Louis, WY 56410-7837  93 Ex
PM
        9995      966 Castaneda Locks\nWest Juliafurt, CO 96415  92 XI
PM
        9996  832 Curtis Dam Suite 785\nNorth Edwardburgh, T...  41 JY
AM
```

```
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AM
        9998               0096 English Rest\nRoystad, IA 12457  74 cL
PM
        9999     40674 Barrett Stravenue\nGrimesville, WI 79682  64 Hr
AM


                                                Browser Info  \
        9990  Mozilla/5.0 (Macintosh; Intel Mac OS X 10_7_4;...
        9991  Mozilla/5.0 (compatible; MSIE 8.0; Windows NT ...
        9992  Mozilla/5.0 (Macintosh; PPC Mac OS X 10_6_5) A...
        9993  Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_8...
        9994  Opera/9.68.(X11; Linux x86_64; sl-SI) Presto/2...
        9995  Mozilla/5.0 (Windows NT 5.1) AppleWebKit/5352 ...
        9996  Mozilla/5.0 (compatible; MSIE 9.0; Windows NT ...
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        9998  Mozilla/5.0 (Macintosh; Intel Mac OS X 10_8_8;...
        9999  Mozilla/5.0 (X11; Linux i686; rv:1.9.5.20) Gec...


                              Company       Credit Card CC Exp Date
\
        9990  Pace, Vazquez and Richards   869968197049750       04/24
        9991                Snyder Inc  4221582137197481       02/24
        9992                 Wells Ltd  4664825258997302       10/20
        9993             Colon and Sons    30025560104631       10/25
        9994               Ritter-Smith  3112186784121077       01/25
        9995              Randall-Sloan   342945015358701       03/22
        9996    Hale, Collins and Wilson   210033169205009       07/25
        9997               Anderson Ltd  6011539787356311       05/21
        9998                   Cook Inc   180003348082930       11/17
```

```
        9999                  Greene Inc  4139972901927273       02/19


             CC Security Code       CC Provider
Email  \
        9990               877      JCB 15 digit
andersonmichael@sherman.biz
        9991               969           Voyager
kking@wise-liu.com
        9992               431          Discover
bberry@wright.net
        9993               629           Maestro
chelseawilliams@lopez.biz
        9994              1823           Maestro
iroberts@gmail.com
        9995               838      JCB 15 digit
iscott@wade-garner.com
        9996               207      JCB 16 digit
mary85@hotmail.com
        9997                 1     VISA 16 digit
tyler16@gmail.com
        9998               987  American Express
elizabethmoore@reid.net
        9999               302      JCB 15 digit
rachelford@vaughn.com


                                      Job       IP Address Language
Purchase Price
        9990           Early years teacher     54.170.3.185       ru
18.35
        9991         IT sales professional    254.25.31.156       el
25.93
        9992                 Set designer    174.173.51.32       de
67.96
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        9993  Designer, exhibition/display    177.46.82.128       el
65.61
        9994     Education officer, museum    242.44.112.18       zh
31.85
        9995                    Printmaker    29.73.197.114       it
82.21
        9996               Energy engineer   121.133.168.51       pt
25.63
        9997            Veterinary surgeon    156.210.0.254       el
83.98
        9998      Local government officer     55.78.26.143       es
38.84
        9999        Embryologist, clinical  176.119.198.199       el
67.59


Code cell <3VzAu3NhFctO>
# %% [code]
df.dtypes
Execution output from Apr 20, 2024 12:59 PM
1KB
    text/plain
        Address               object
        Lot                   object
        AM or PM              object
        Browser Info          object
        Company               object
        Credit Card            int64
        CC Exp Date           object
        CC Security Code       int64
        CC Provider           object
        Email                 object
```

```
        Job                  object
        IP Address           object
        Language             object
        Purchase Price      float64
        dtype: object


Code cell <4kRhlHwhFklA>
# %% [code]
df.isnull().sum()
Execution output from Apr 20, 2024 1:00 PM
0KB
    text/plain
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        Lot                  0
        AM or PM             0
        Browser Info         0
        Company              0
        Credit Card          0
        CC Exp Date          0
        CC Security Code     0
        CC Provider          0
        Email                0
        Job                  0
        IP Address           0
        Language             0
        Purchase Price       0
        dtype: int64


Code cell <Puw3FdOWFvwW>
```

```
# %% [code]
len(df.columns)
Execution output from Apr 20, 2024 1:00 PM
0KB
    text/plain
        14


Code cell <FZ4aC5uRF_UQ>
# %% [code]
len(df)
Execution output from Apr 20, 2024 1:00 PM
0KB
    text/plain
        10000


Code cell <Sx62YDL8GErF>
# %% [code]
df.info()
Execution output from Apr 20, 2024 1:00 PM
1KB
    Stream
        <class 'pandas.core.frame.DataFrame'>
        RangeIndex: 10000 entries, 0 to 9999
        Data columns (total 14 columns):
         #   Column            Non-Null Count  Dtype
        ---  ------            --------------  -----
         0   Address           10000 non-null  object
         1   Lot               10000 non-null  object
         2   AM or PM          10000 non-null  object
```

```
 3   Browser Info      10000 non-null  object
 4   Company           10000 non-null  object
 5   Credit Card       10000 non-null  int64
 6   CC Exp Date       10000 non-null  object
 7   CC Security Code  10000 non-null  int64
 8   CC Provider       10000 non-null  object
 9   Email             10000 non-null  object
 10  Job               10000 non-null  object
 11  IP Address        10000 non-null  object
 12  Language          10000 non-null  object
 13  Purchase Price    10000 non-null  float64
dtypes: float64(1), int64(2), object(11)
memory usage: 1.1+ MB


Code cell <VMtrxIM1GJ1I>
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df.columns
Execution output from Apr 20, 2024 1:00 PM
0KB
    text/plain
        Index(['Address', 'Lot', 'AM or PM', 'Browser Info', 'Company',
'Credit Card',
               'CC Exp Date', 'CC Security Code', 'CC Provider',
'Email', 'Job',
               'IP Address', 'Language', 'Purchase Price'],
              dtype='object')


Code cell <J8LbEhVpGhLD>
# %% [code]
df['Purchase Price'].max()
```

```
Execution output from Apr 20, 2024 1:00 PM
0KB
    text/plain
        99.99


Code cell <ASl0WNTxHCsT>
# %% [code]
df['Purchase Price'].min()
Execution output from Apr 20, 2024 1:00 PM
0KB
    text/plain
        0.0


Code cell <0fj9MwJCHRp2>
# %% [code]
df['Purchase Price'].mean()
Execution output from Apr 20, 2024 1:00 PM
0KB
    text/plain
        50.347302


Code cell <q8d5tyc0Hc5C>
# %% [code]
df.columns
Execution output from Apr 20, 2024 1:00 PM
0KB
    text/plain
        Index(['Address', 'Lot', 'AM or PM', 'Browser Info', 'Company',
'Credit Card',
```

```
               'CC Exp Date', 'CC Security Code', 'CC Provider',
'Email', 'Job',
               'IP Address', 'Language', 'Purchase Price'],
              dtype='object')


Code cell <esOY5-8-HmDS>
# %% [code]
df['Language']=='fr'
Execution output from Apr 20, 2024 1:00 PM
0KB
    text/plain
        0       False
        1        True
        2       False
        3       False
        4       False
                ...
        9995    False
        9996    False
        9997    False
        9998    False
        9999    False
        Name: Language, Length: 10000, dtype: bool


Code cell <Q-3fffM-HwNq>
# %% [code]
len(df[df['Language']=='fr'])
Execution output from Apr 20, 2024 1:00 PM
0KB
```

```
    text/plain

        1097


Code cell <kybgEUgjIEn3>

# %% [code]

df[df['Language']=='fr'].count()

Execution output from Apr 20, 2024 1:00 PM

1KB

    text/plain

        Address             1097

        Lot                 1097

        AM or PM            1097

        Browser Info        1097

        Company             1097

        Credit Card         1097

        CC Exp Date         1097

        CC Security Code    1097

        CC Provider         1097

        Email               1097

        Job                 1097

        IP Address          1097

        Language            1097

        Purchase Price      1097

        dtype: int64


Code cell <hSEwKEPgIT-0>

# %% [code]

df.columns

Execution output from Apr 20, 2024 1:00 PM
```

```
0KB

    text/plain

        Index(['Address', 'Lot', 'AM or PM', 'Browser Info', 'Company',
'Credit Card',

               'CC Exp Date', 'CC Security Code', 'CC Provider',
'Email', 'Job',

               'IP Address', 'Language', 'Purchase Price'],

              dtype='object')


Code cell <ARLft1GuIa4e>

# %% [code]

len(df[df['Job'].str.contains('engineer',case=False)])

Execution output from Apr 20, 2024 1:00 PM

0KB

    text/plain

        984


Code cell <EDmqWDciJOEP>

# %% [code]

df.columns

Execution output from Apr 20, 2024 1:01 PM

0KB

    text/plain

        Index(['Address', 'Lot', 'AM or PM', 'Browser Info', 'Company',
'Credit Card',

               'CC Exp Date', 'CC Security Code', 'CC Provider',
'Email', 'Job',

               'IP Address', 'Language', 'Purchase Price'],

              dtype='object')
```

```
Code cell <m4Zalu90JU77>

# %% [code]

df[df['IP Address']=="132.207.160.22"]['Email']

Execution output from Apr 20, 2024 1:01 PM

0KB

    text/plain

        2    amymiller@morales-harrison.com

        Name: Email, dtype: object


Code cell <NG88q-RJD2k0>

# %% [code]

len(df[(df['CC Provider']=="MasterCard") & (df['Purchase Price']>50)])

Execution output from Apr 20, 2024 1:01 PM

0KB

    text/plain

        0


Code cell <a2j5EPv6J2Ac>

# %% [code]

df[(df['CC Provider']=="Mastercard") \

 & (df['Purchase Price']>50)].count()

Execution output from Apr 20, 2024 1:01 PM

0KB

    text/plain

        Address             405

        Lot                 405

        AM or PM            405

        Browser Info        405

        Company             405
```

```
        Credit Card         405
        CC Exp Date         405
        CC Security Code    405
        CC Provider         405
        Email               405
        Job                 405
        IP Address          405
        Language            405
        Purchase Price      405
        dtype: int64


Code cell <hXzJ3YUWKZ2c>
# %% [code]
df[df['Credit Card']==4664825258997302]["Email"]
Execution output from Apr 20, 2024 1:01 PM
0KB
    text/plain
        9992    bberry@wright.net
        Name: Email, dtype: object


Code cell <c-yFukLXKlAk>
# %% [code]
df['AM or PM'].value_counts()
Execution output from Apr 20, 2024 1:01 PM
0KB
    text/plain
        AM or PM
        PM    5068
        AM    4932
```

```
        Name: count, dtype: int64


Code cell <GhrdUDX6LjhM>
# %% [code]
df['CC Exp Date']
Execution output from Apr 20, 2024 1:01 PM
0KB
    text/plain
        0       02/20
        1       11/18
        2       08/19
        3       02/24
        4       10/25
                ...
        9995    03/22
        9996    07/25
        9997    05/21
        9998    11/17
        9999    02/19
        Name: CC Exp Date, Length: 10000, dtype: object


Code cell <OPySwPYALvTv>
# %% [code]
def fun():
    count=0
    for date in df['CC Exp Date']:
        if date.split('/')[1]=='20':
         count=count+1
    print(count)
```

```
Code cell <CXaujC7tMz-x>
# %% [code]
fun()
Execution output from Apr 20, 2024 1:01 PM
0KB
    Stream
        988


Code cell <K2w5C6nZM2NR>
# %% [code]
len(df[df['CC Exp Date'].apply(lambda x:x [3:]=='20')])
Execution output from Apr 20, 2024 1:01 PM
0KB
    text/plain
        988


Code cell <6rBTv07vNXjg>
# %% [code]
list1=[]
for email in df['Email']:
  list1.append(email.split('@')[1])


Code cell <Ytg7P7PWNvAX>
# %% [code]
df['temp']=list1


Code cell <L6EqDwnkN1dD>
# %% [code]
```

```
df.head(1)
```

```
Execution output from Apr 20, 2024 1:01 PM
```

```
11KB
```

```
    text/plain
```

```
        Address    Lot AM or PM  \
        0  16629 Pace Camp Apt. 448\nAlexisborough, NE 77...  46 in
PM


                                                Browser Info
Company  \
        0  Opera/9.56.(X11; Linux x86_64; sl-SI) Presto/2...
Martinez-Herman


               Credit Card CC Exp Date  CC Security Code   CC Provider
\
        0  6011929061123406       02/20               900  JCB 16 digit


                     Email                                        Job
IP Address  \
        0  pdunlap@yahoo.com  Scientist, product/process development
149.146.147.205


          Language  Purchase Price       temp
        0       el           98.14  yahoo.com
```

```
Code cell <np5SwK-dN6e6>
```

```
# %% [code]
```

```
df['temp'].value_counts().head()
```

```
Execution output from Apr 20, 2024 1:02 PM
```

```
0KB
```

```
    text/plain
```

```
        temp

        hotmail.com     1638

        yahoo.com       1616

        gmail.com       1605

        smith.com         42

        williams.com      37

        Name: count, dtype: int64


Code cell <77sJk4q1OJm8>

# %% [code]

df['Email'].apply(lambda x:x.split('@')[1]).value_counts().head()

Execution output from Apr 20, 2024 1:02 PM

0KB

    text/plain

        Email

        hotmail.com     1638

        yahoo.com       1616

        gmail.com       1605

        smith.com         42

        williams.com      37

        Name: count, dtype: int64
```

# CONCLUSION

Email has been the most important medium of communication nowadays, through internet connectivity any message can be delivered to all aver the world. More than 270 billion emails are exchanged daily, about 57% of these are just spam emails. Spam emails, also known as non-self, are undesired commercial or malicious emails, which affects or hacks personal information like bank ,related to money or anything that causes destruction to single individual or a corporation or a group of people. Besides advertising, these may contain links to phishing or malware hosting websites set up to steal confidential information. Spam is a serious issue that is not just annoying to the end-users but also financially damaging and a security risk. Hence this system is designed in such a way that it detects unsolicited and unwanted emails and prevents them hence helping in reducing the spam message which would be of great benefit to individuals as well as to the company .In the future this system can be implemented by using different algorithms and also more features can be added to the existing system.

# FUTURE SCOPE

The future scope of email spam detection is wide-ranging and holds considerable potential for innovation and improvement. Here are several areas that represent promising directions for future development

- **Enhanced Accuracy with AI and Machine Learning**
- **Behavioral Analysis and Contextual Understanding**
- **Multi-Modal Analysis**
- **Real-Time Threat Intelligence and Collaboration**
- **Privacy-Preserving Techniques**
- **Cross-Platform Integration**
- **Adaptive and Self-Learning Systems**
- **Explainable AI (XAI)**

# REFERENCES

[1] S. H. a. M. A. T. Toma, "An Analysis of Supervised Machine Learning Algorithms for Spam Email Detection," in International Conference on Automation, Control and Mechatronics for Industry 4.0 (ACMI), 2021.

[2] S. Nandhini and J. Marseline K.S., "Performance Evaluation of Machine Learning Algorithms for Email Spam Detection," in International Conference on Emerging Trends in Information Technology and Engineering (ic-ETITE), 2020.

[3] A. L. a. S. S. S. Gadde, "SMS Spam Detection using Machine Learning and Deep Learning Techniques," in 7th International Conference on Advanced Computing and Communication Systems (ICACCS), 2021, 2021.

[4] V. B. a. B. K. P. Sethi, "SMS spam detection and comparison of various machine learning algorithms," in International Conference on Computing and Communication Technologies for Smart Nation (IC3TSN), 2017.

[5] G. D. a. A. R. P. Navaney, "SMS Spam Filtering Using Supervised Machine Learning Algorithms," in 8th International Conference on Cloud Computing, Data Science & Engineering (Confluence), 2018

## CODE

**Please Provide Code through Git Hub Repo Link**

https://github.com/programercharan/charan/tree/main

## VIDEO IN GITHUB LINK

https://github.com/programercharan/charan/assets/167452675/8795387e-a94d-4c69-bb10-b93f0ca7aaea

## ALGORITHM LINK IN GITHUB

https://github.com/programercharan/charan/blob/main/algorthim.pdf

## PPT LINK IN GITHUB

https://github.com/programercharan/charan/blob/main/algorthim.pdf